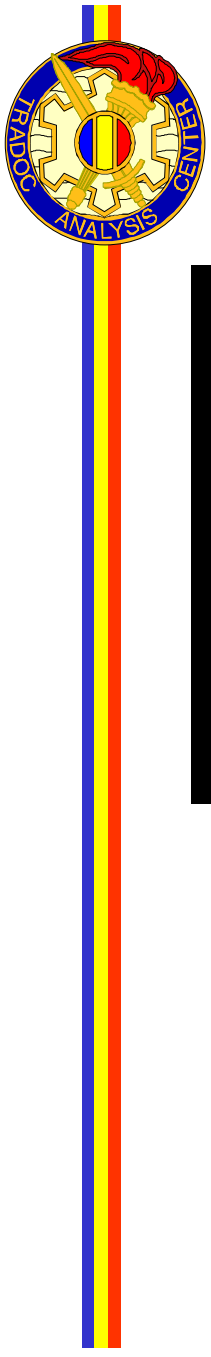

U.S. Army TRADOC Analysis Center
Naval Postgraduate School
Monterey, CA 93943

TRAC-MONTEREY

FY2000 RESEARCH PLAN

for the

U.S. ARMY TRADOC ANALYSIS CENTER (TRAC) - MONTEREY

Center for
Advanced Simulation Research

Lieutenant Colonel Jeffrey A. Appleget, Ph.D.
Director, TRAC-Monterey
Monterey, California

Mr. Michael F. Bauman, SES
Director, TRAC
Fort Leavenworth, Kansas

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I. ADVANCED SIMULATION RESEARCH CENTER

TRAC-Monterey Mission

TRAC-Monterey is the Center for Advanced Simulation Research. We provide a full-time analytical capability to the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC). TRAC-Monterey performs the following functions:

- Research in two major areas: 1) leading-edge computer simulation concepts and advanced technologies for modeling military operations focusing on system interoperability in distributed environments; and 2) practical, real-world military operations research problems.

- Support to the Naval Postgraduate School (NPS). Support includes applicable and professionally enriching military oriented 'experience tours', and course projects and Masters theses topics for officers from all branches of service attending NPS.

- Strong outreach program that maintains close ties with TRAC and various Army commands and agencies.

TRAC-Monterey's two major research thrusts, leading-edge computer simulation research and real-world military operations research problems, ensure the Center remains relevant and closely linked with the Army. The trend in combat simulations is to link dissimilar constructive and virtual simulations to enhance collective and Joint training. TRAC-Monterey possesses significant experience linking simulations using Distributed Interactive Simulation (DIS) protocols and the High Level Architecture (HLA). Additionally, TRAC-Monterey analysts regularly brief findings of distributed simulation research at DoD-sponsored workshops and international conferences.

NPS supports the Center's research initiatives with world-class faculty and students. TRAC-Monterey's research program offers NPS faculty a broad range of opportunities for studying challenging, applied problems that support NPS curricula and enhancing professional development.

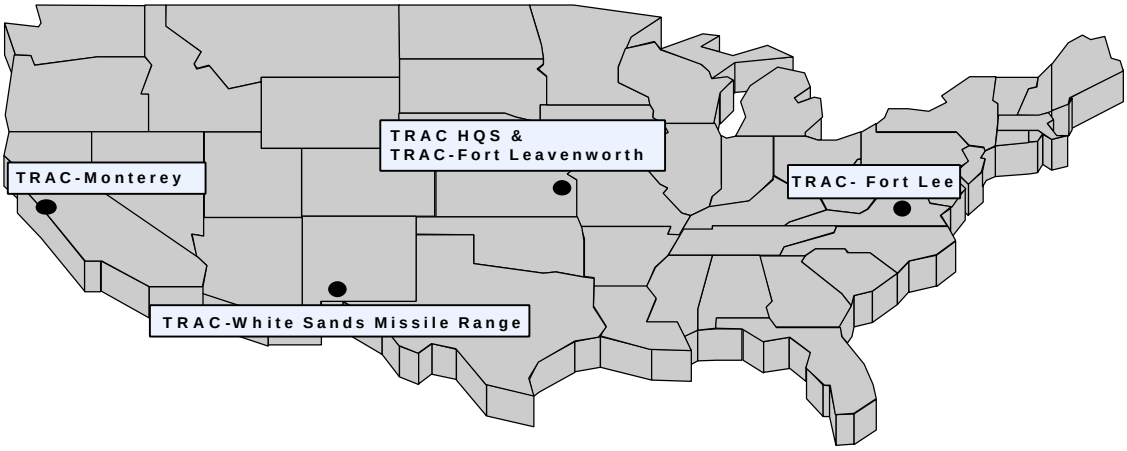
The Center's research program also supports students from all branches of military service and allied officers with opportunities to investigate a wide range of interdisciplinary issues. TRAC's research program is particularly well suited to military officers who wish to apply operations research, applied mathematics, engineering, and computer science concepts studied in the classroom to solve real-world military problems.

Organization and Facilities

TRAC Headquarters is located at Fort Leavenworth, Kansas. TRAC-Monterey is one of four analysis centers organized under TRAC Heaquarters. The other centers shown in Figure 1 are TRAC-Fort Leavenworth, Kansas, TRAC-White Sands Missile Range, New Mexico, and TRAC-Fort Lee, Virginia.

TRAC-Monterey is located on the grounds of the Naval Postgraduate School, Monterey, California, and occupies office and laboratory space on the second and third floors of Building 203. Facilities on the 2d floor include offices for the director, analysts, administrative personnel, and a conference room. The 3d floor consists of a combat simulation laboratory, contractor and student work areas, and conference room.

Figure 1. U.S. Army TRADOC Analysis Center (TRAC) Sites



Personnel

The TRAC-Monterey Table of Distribution and Allowances (TDA) authorizes a director (O5), five military operations research analysts (O4/O3), and an administrative staff. Table 1 identies the TRAC-Monterey Research Council. The Council consists of the director and assigned analysts. The Research Council is responsible for accomplishing the FY2000 Research Plan.

Table 1. TRAC-Monterey Research Council

POSITION	NAME	PHONE	EMAIL
Director	LTC Jeffrey A. Appleget, Ph.D	DSN 878-3088	applegetj@trac.nps.navy.mil
Analyst	MAJ Theodore D. Dugone, M.Sc.	DSN 878-4057	dugonet@trac.nps.navy.mil
Analyst	MAJ LeRoy A. Jackson, M.Sc.	DSN 878-4061	jacksonl@trac.nps.navy.mil
Analyst	MAJ Gerald M. Pearman, M.Sc.	DSN 878-4062	pearmang@trac.nps.navy.mil
Analyst	CPT James E. Illingworth, M.Sc.	DSN 878-4060	illingwj@trac.nps.navy.mil
Analyst	SFC Cary C. Augustine	DSN 878-4059	augustic@trac.nps.navy.mil

TRAC-Monterey augments its research capability through various sources. A major source of support comes from NPS faculty who conduct TRAC-sponsored research. A second source is NPS Masters students who work on TRAC-sponsored projects and who are advised by NPS faculty. Finally, private contractors provide software development support and assistance with proof-of-principle demonstrations.

II. FY2000 RESEARCH PLAN

Purpose of the Research Plan

The FY2000 Research Plan formalizes TRAC-Monterey's research and problem-solving activities for the upcoming fiscal year. The plan provides a concise summary of each applied research project undertaken by TRAC-Monterey. The summaries include the title, client(s), problem statement, proposal of work, requirements and milestones, deliverables, estimated man-years, investigator(s), contractor(s), and references. The plan also serves as a means of announcing TRAC-Monterey's research activities to other TRAC offices, NPS faculty and students, and various agencies throughout DoD.

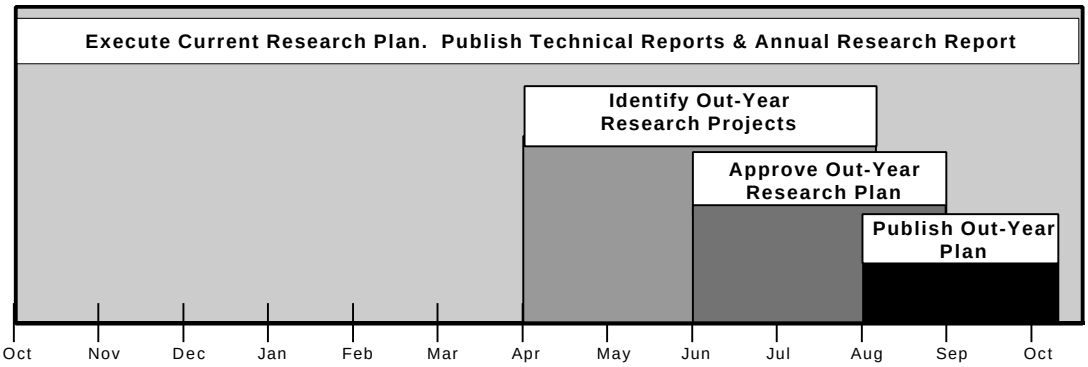
The Research Plan is divided into two main categories: funded and unfunded. Both funded and unfunded projects were approved by the TRAC-Monterey Research Council as viable and applicable research projects. TRAC-Monterey will complete unfunded projects if required funds become available during FY00. In certain cases, the TRAC-Monterey director may determine that an unfunded project has high payoff value and direct an analyst to initiate the project with available resources.

Annual Research Cycle

TRAC-Monterey's Annual Research Cycle begins in October and continues through the middle of October the following year. The major phases of the research cycle are illustrated in Figure 2. The white bands depict the time periods and major tasks for each phase.

The research cycle begins by identifying potential research projects for the upcoming fiscal year. Potential projects include new and on-going projects (i.e., those carried forward from the previous year). During this phase, TRAC-Monterey analysts prepare research proposals for potential projects. In the second phase, the TRAC-Monterey Research Council reviews each project proposal. The Council assesses the project's potential value to the Army and its contribution to TRAC-Monterey's major research thrusts. The Council also determines whether private contractors are necessary to complete required tasks and if funding is available for the contractors. Finally, TRAC-Monterey publishes the Annual Research Plan and begins research for the fiscal year. Publication of the Center's Annual Research Report, summarizing research accomplished during the previous year and notable briefings and presentations, completes the annual research cycle.

Figure 2. TRAC-Monterey Research Cycle



III. FUNDED RESEARCH FOR FY00

HLA WARRIOR

PROJECT FY00-01

CLIENT ORGANIZATION

Headquarters, U.S. Army TRADOC Analysis Center (TRAC), ATTN: ATRC, Fort Leavenworth, KS 66027. Point of Contact: Mr. Michael F. Bauman, SES, Director, TRAC, Fort Leavenworth, KS 66027. DSN: 552-5132. baumanm@trac.army.mil

PROBLEM STATEMENT

Developers of next generation simulations lack test cases to assess the benefit of applying modern technologies to combat simulations and to explore integration issues. TRAC–Monterey, CA and the National Simulation Center (NSC), Fort Leavenworth, KS propose to jointly research new computer software technologies and methodologies for re-hosting legacy computer simulations to modern platforms and paradigms. The primary purpose of this research is to investigate and demonstrate the application of advanced technologies for re-engineering and re-hosting legacy simulations in support of future combat simulations, such as Combat XXI and OneSAF. Janus is the test case for this project.

Baseline requirements include porting Janus to a high-end personal computer (PC) running Windows NT (WinNT), creating a new modular simulation architecture, rewriting source code using an object-oriented language, creating new graphical user interfaces (GUIs) using Vision XXI management tools, complying with Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) requirements, and incorporating Janus version 6.3 and some Janus 6.88 functionality. When complete, the re-engineered model will be called *HLA Warrior*.

PROPOSAL OF WORK

This research will be accomplished in two phases. First, TRAC-Monterey coordinates and leads re-engineering effort incorporating baseline requirements. Next, NSC assumes lead for model integration, which includes integration of Operations Other Than War (OOTW) and Urban Warfare functionality into the re-engineered model, as well as linking the model to the Army's command, control, communications, computers, and intelligence (C4I) systems. As a separate project, TRAC-Monterey will conduct a statistical validation of Warrior following the proof of principle demonstration.

REQUIREMENTS AND MILESTONES

- Second Beta release to test sites. Includes GUI functionality integrated with majority of model functionality. (OCT 99)
- Develop scenarios for Proof-of-Principle exercise. (NOV 99)
- Final prototype demonstration in a Proof-of-Principle exercise. (DEC 99)
- Write Technical Report. (APR 00)

DELIVERABLES

- Prototype HLA Warrior.
- Technical Report.

ESTIMATED MAN YEARS

- Lead investigator: 1/2 man years.

LEAD INVESTIGATOR

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Rolands & Associates (R&A), POC Mr. William Caldwell, 500 Sloat Avenue, Monterey, CA 93940. (831) 373-2841.

Tapestry Solutions, Inc., POC Galen Aswegan, 5675 Ruffin Road, Suite 305, San Diego, CA 92123. (619) 503-1990.

HLA WARRIOR STATISTICAL VALIDATION

PROJECT FY00-02

CLIENT ORGANIZATION

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PROBLEM STATEMENT

HLA Warrior is a high-resolution combat simulation that incorporates Janus algorithms and functionality. Using a bottom-up approach, Warrior developers assessed Janus source code and converted existing Janus functionality from FORTRAN to C++. Warrior was also ported to operate on a PC running Windows NT vice a UNIX operating system. Other Warrior baseline requirements include implementing a new modular system architecture, creating new graphical user interfaces (GUIs) using Vision XXI management tools, and complying with Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) requirements.

The premise is, given that Warrior incorporates Janus algorithms and functionality, Warrior scenarios should produce statistically similar results as Janus scenarios. Also, since Janus is validated by use, statistically similar results between Warrior and Janus will support Warrior validation. TRAC-Monterey will investigate how consistently and accurately Warrior reproduces Janus data by comparing measures of performance (MOPs) for scenarios executed in stand-alone Warrior to MOPs for the same scenarios executed in stand-alone Janus. Follow-on research will include comparison of distributed Warrior scenarios to distributed Janus scenarios.

PROPOSAL OF WORK

Develop movement to contact and defensive scenarios that include US and Russian-made systems. Probable terrain includes Fort Hunter Liggett and/or Southwest Asia. Develop appropriate MOPs for comparison between Warrior and Janus. Execute scenarios in both Warrior and Janus, conducting a sufficient number of runs to achieve a satisfactory sample size. Compare Warrior and Janus test results using rigorous statistical methods. Probable statistical tests include the Analysis of Variance (ANOVA) test, two-sample *t*-test, and non-parametric Wilcoxon test. Time permitting, determine cause of any disparities between Warrior and Janus, make appropriate code changes to resolve disparity, and re-run scenarios.

REQUIREMENTS AND MILESTONES

- Develop scenarios and MOPs (JAN 00).
- Run scenarios (FEB 00).

- Conduct statistical analysis (APR 00).
- Report conclusions and recommendations (MAY 00).

DELIVERABLES

- Master's thesis.

ESTIMATED MAN YEARS

- Lead investigator: 1/4 man years.

LEAD INVESTIGATOR

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CONTRACTOR

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REFERENCES

Pearman, G.M., "Comparison Study of Janus and JLink," Naval Postgraduate School Masters Thesis, Monterey, CA, June 1997.

MODULAR TERRAIN FOR ENTITY LEVEL COMPUTER GENERATED FORCES (ModTerrain)

PROJECT FY00-03

CLIENT ORGANIZATION

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Headquarters, US Army TRADOC Analysis Center (TRAC), Warrior Project Officer. Point of Contact: MAJ Gerald Pearman. DSN 878-4062. pearmang@trac.nps.navy.mil

PROBLEM STATEMENT

Problem. Terrain correlation has been one of the most pressing interoperability issues in the distributed simulation community. Terrain miscorrelation causes a number of undesirable effects such as unfair fights among entities, degraded simulation realism, and invalid exercise results. For simulations of Computer Generated Forces (CGF), terrain correlation problems can be largely be attributed to a lack of database interchange formats and to differences in runtime terrain representations. For visually oriented simulators/simulations, internal processing and graphical display of terrain databases further contribute to the correlation problems.

Architecture. The High Level Architecture (HLA) has been designed to facilitate interoperability of all type of models and simulations, as well as reuse of their components. It does not, however, ensure that the various types of synthetic environment databases used by heterogeneous simulation systems are correlated (i.e., spatially consistent).

Data Interchange. The Synthetic Environment Data Representation Interchange Specification (SEDRIS) provides a mechanism for unambiguous and loss-less interchange of data for synthetic environment databases. SEDRIS furthers interoperability significantly, however, applications will continue to use dissimilar runtime terrain representations. Some of the derived runtime terrain databases may be based on an irregular network of polygons (polygonal type) while others may be based on a regular grid (gridded type). Runtime terrain databases with similar representations may have very different resolution limitations. Correlation problems will still arise when simulations which use dissimilar runtime representations are linked together.

Composability and Interoperability. Composability and interoperability were identified as two of the three highest technical risks in OneSAF development. The limiting factor in simulation scalability is often the run-time terrain database resolution capacity. The OneSAF operation requirements document (ORD) requires that “the OneSAF architecture must be able

to operate using multiple terrain database formats." The OneSAF technical analysis concludes that the architecture "should provide uniform APIs between major system partitions and enforce the consistent use of these interfaces across the system to facilitate software maintenance and evolution." In most simulations, terrain is partitioned with externally defined terrain database files.

PROPOSAL OF WORK

We propose to design an interface and prototype a modular run-time terrain component that will hide the details of the terrain representation from an entity level CGF system. This is much like the mechanism provided by HLA to abstract away the details of data distribution management. This component will contain a standard set of terrain services that will allow the application to use the terrain database independent of the underlying terrain representation. By using such a set of routines, legacy simulations and emerging CGF systems can use different terrain formats at run-time without source code changes. The run-time terrain representation could also be changed internally without impacting systems that already use the existing set of standard terrain services. Also, the interface could be extended to provide those services not anticipated or not currently required by most CGF systems.

The project team will (1) study several run-time terrain formats such as ModSAF CTDB, CCTT SIF++, Multigen FLT, and Janus; (2) identify the common terrain services within entity level CGF systems; (3) examine some commonly used interchange representations such as SEDRIS, S1000, and Multigen FLT; (4) develop an API specification for a standard set of CGF terrain services; (5) code one baseline prototype terrain module using the API; (6) experiment with the baseline terrain module to determine its performance properties; (7) obtain two run-time terrain databases derived from a common source; and (8) demonstrate that an entity level simulation can use either module in a simulation exercise.

REQUIREMENTS AND MILESTONES

The project consists of three distinct phases each culminating with the distribution of a written product.

Phase I. Preliminary API Definition (March 1999). In Phase I, we propose a standard API definition and develop a detailed implementation methodology. Phase I culminates with the distribution of a draft API standard to the SAF, Terrain and Object Management SCCs. *(Phase I was completed in March 1999)*

Phase II. Prototype Development & Experimentation (September 1999). In Phase II, we implement a prototype terrain module using the draft standard and conduct a series of experiments to benchmark the performance characteristics of the prototype. We document the API specification in a functional description document and describe the prototype implementation and the experimental results in a report. Phase II culminates with the distribution of the functional description and the experimental report. *(Phase II will be completed in November 1999)*

Phase III. Demonstration, Testing & Documentation (June 2000). In Phase III, we integrate the prototype terrain module into an entity level simulation and demonstrate that composability has been attained. The demonstration (POP-D) will prove that an entity level simulation can use two different run-time terrain representations through the standard API. Phase III culminates with the distribution of a final technical report detailing the results for the entire project.

DELIVERABLES

- Standards nomination for the run-time terrain module API specification
- Prototype (ModSAF CTDB or similar) run-time terrain module using the standard
- Technical report on the prototype and the experiment
- Proof of principle demonstration (POP-D)
- Final technical report

ESTIMATED MAN YEARS

- Lead investigator: 1/2 man years.

LEAD INVESTIGATOR

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CONTRACTOR

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TRACER/FSCS HIGH RESOLUTION TERRAIN ANALYSIS

PROJECT FY00-04

CLIENT ORGANIZATION

Headquarters, U. S. Army TRADOC Analysis Center (TRAC), ATTN: ATRC, Fort Leavenworth, KS. Point of Contact: Mr. Michael F. Bauman, SES, Director, TRAC, Fort Leavenworth, KS 66027. (931) 684-5132, (DSN: 552-5132), baumanm@trac.army.mil

PROBLEM STATEMENT

TRAC-Leavenworth (TRAC-FLVN) requires a study of stealth and acquisition capabilities of the TRACER/FSCS against enemy systems on high-resolution terrain (1 meter). The purpose of the study is to provide a proof-of-principle for analysts and scout subject matter experts to take advantage of micro-terrain as they maneuver scout systems in a tactical setting. A second purpose of the study is to assess FSCS capabilities and technologies relative to current scout system capabilities using the micro-terrain database. Planners and decision-makers will use the results to determine whether micro-terrain can be used in the Research & Development phase of adding new or replacing current weapon systems in the United States Army inventory.

PROPOSAL OF WORK

This research will be accomplished in two phases. The first phase consists of modifying the current micro-terrain database program, Perspective View on NT (PVNT), to accept the required input parameters and produce the required output data streams for the study. The Naval Postgraduate School (NPS) will accomplish phase one. Phase two will require TRAC-Leavenworth to provide tactical experts to build the required scenarios for the study. NPS and TRAC-Monterey will execute the scenarios on the modified PVNT platform.

REQUIREMENTS AND MILESTONES

- PVNT design modification. This includes modification to accept the required input parameters and producing the output data streams in the proper format. (OCT 99)
- PVNT modification execution. This verifies that PVNT properly processes the input parameters and generates the formatted data stream using a test case. (DEC 99)
- TRACER/FSCS Analysis. (JAN 00)
- Write coordinated final report and scripted briefing. (MAR 00)

DELIVERABLES

- PVNT modified executable program.
- TRACER/FSCS analysis.
- Coordinated final report and scripted brief.

ESTIMATED MAN YEARS

- Lead investigator: 1/4 man years.

LEAD INVESTIGATOR

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ACQUISITION CENTER FOR RESEARCH AND LESSONS LEARNED

PROJECT FY00-05

CLIENT ORGANIZATION

Office of the Assistant Secretary of the Army (Acquisition, Logistics and Technology), ATTN: SAAL-ZAC (Acquisition Career Management Office) 2511 Jefferson Davis Highway, 10th Floor Arlington, VA 22202-3911. Point of Contact: Mr. Craig A. Spisak, (703) 604-7101, (DSN 664-7101), FAX: 703-604-8178, craig.spisak@sarda.army.mil

PROBLEM STATEMENT

The acquisition community lacks tools, processes, and procedures for capturing and disseminating "lessons learned" (ref.1). Because little explicit attention is given to "lessons learned" in acquisition, it is difficult to assess the extent to which lessons may or should be applied in various situations. Further, in the current defense acquisition environment, practitioners do not have the opportunities, resources, nor incentives to reflect upon, assess, and report on their experiences. Finally, no current effective mechanism exists for understanding and communicating research needs of acquisition practitioners and policy-makers.

In order to enhance the development and dissemination of acquisition lessons learned, the acquisition community needs new resources. This project will develop a central web-site for their personnel to view past lessons learned in the acquisition process. Both 'improve' and 'sustain' lessons learned posted to a central location will benefit the acquisition community. A central web-site will contribute to "organizational learning" (Argyris and Schon, 1978), thereby improving the acquisition process by identifying costly mistakes and providing positive guidance to practitioners currently conducting acquisition procedures.

A secondary focus of this work will be the displaying of theses by acquisition students and possible theses topics identified by the acquisition community. Posting theses research to the web-site gives visibility to the research already conducted by previous students.

PROPOSAL OF WORK

This research will be accomplished in two phases. The first phase is the development of the web-site. The web-site architecture must include the ability to:

1. Store numerous documents for retrieval;
2. Ease of use by the internet user; and
3. Ability of acquisition students and personnel to submit lessons learned, theses, and possible research topics for posting to the Acquisition CENTRALL web-site.

The second phase will be the management of the document repository by NPS (Dr. Snider), and web-site maintenance by TRAC-Monterey. Submissions to the document repository will be reviewed and approved for publishing on the Acquisition CENTRALL web-site by NPS. This has the possibility of becoming an ongoing event.

REQUIREMENTS AND MILESTONES

- Acquisition CENTRALL Web-site Design. This entails the web-site architecture development and posting to the Internet. (NOV 99)
- Review and Approval of submissions for posting. (ongoing)
- Web-site maintenance. (ongoing)
- Write technical report.

DELIVERABLES

- Acquisition CENTRALL Web-site.
- Submission Review and Posting.
- Technical Report.

ESTIMATED MAN YEARS

- Lead investigator: 1/4 man years.

LEAD INVESTIGATOR

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REFERENCES

Department of Defense. (1993). "Acquisition-Type Lessons-Learned Programs within the Military Departments." Report No. 93-173. Office of the Inspector General.

Argyris, C. & D.A. Schon (1978). *Organizational Learning: A Theory of Action Perspective.* Reading, Mass.: Addison-Wesley.

LAND WARRIOR TRAINING INITIATIVE

PROJECT FY00-06

CLIENT ORGANIZATION

Program Manager (PM) Soldier. Point of Contact: COL Bruce Jette, Project Manager, Fort Belvoir, VA 22060-5852. (703) 704-3816, (DSN: 654-3816), bjette@pmsoldier.belvoir.army.mil

PROBLEM STATEMENT

The Program Manager Soldier (PM Soldier) is developing a new soldier system called Land Warrior. It is an integrated system that combines the soldier's weapon, helmet assembly, protective clothing and individual equipment, and radio using a computer and software. With the Research & Development phase of acquisition almost complete, several test-beds for the new system will be implemented. To ease the learning curve of the test platoon in using the Land Warrior system, PM Soldier is interested in purchasing and modifying Commercial-Off-The-Shelf-Software (COTS) for use as a training tool. The main intent of the training tool is to exercise the visual and situational awareness of the soldier within a computer environment that integrates several new aspects of the Land Warrior system. The modified COTS will be referred to as the Land Warrior Training Initiative (LWTI).

With the fielding of the Land Warrior system, it is desired that the end-users, or test platoon, have some initial training on the Land Warrior system functionality. Since the release of the system to the test platoon is planned prior to a Joint Readiness Training Center (JRTC) rotation in September 2000, train-up using the LWTI will be required beginning April/May 2000. This requires a quick turn-around time for the deliverables of this project.

PROPOSAL OF WORK

This research will be accomplished in four phases. The first phase is the selection and purchase of the COTS that meets minimum requirements for modification. The second phase is the re-coding of the COTS to add the Land Warrior functionality and system replication. Two major aspects of the re-coding phase are:

1. The evaluation of the COTS source code to identify the structure and architecture; and
2. Modification of the source code into a workable Land Warrior computer environment.

The third phase of this project is the launching of a test-bed version of the modified code to the end-user. This will provide feedback from the users as to the ease of use as well as training benefits gained by the LWTI. Recommended changes to the LWTI code will be fielded by TRAC-Monterey for inclusion into future version releases. The fourth phase is the launching of the final version to the end-user. This will allow the end-user time to learn the LWTI and utilize it for train-up prior to receiving the actual Land Warrior system. The LWTI

final release is planned in conjunction with the train-up for a JRTC rotation of the Land Warrior test platoon.

REQUIREMENTS AND MILESTONES

- Purchase of COTS. (DEC 99)
- COTS re-coding into Basic LWTI, 1st Release. (APR 00)
- LWTI Short-term functionality improvement, 2nd Release. (JUL 00)
- SBA research with Army Research Institute. (APR-SEP 00)
- LWTI Long-term funtionality improvement, 3rd Release. (TBD)
- Write technical report. (NOV 00)

DELIVERABLES

- COTS evaluation and purchase.
- LWTI 1st Release.
- LWTI Final Release.
- Test Platoon LWTI support
- Technical Report.

ESTIMATED MAN YEARS

- Lead investigator: 3/4 man years.

LEAD INVESTIGATOR

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CONTRACTOR

TBD

NPS MILITARY HOUSING CUSTOMER DATABASE

PROJECT FY00-07

CLIENT ORGANIZATION

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PROBLEM STATEMENT

The Naval Support Activity (NSA) at the Naval Postgraduate School (NPS) administers military housing at La Mesa Village in Monterey, California, and Army housing at both the Presidio of Monterey (POM) and the POM Annex at old Fort Ord. Residents include service members from all branches of military service attending NPS and the Defense Language Institute (DLI), as well as permanent party assigned to NPS and DLI. The large student population creates a high turnover rate and presents challenges to forecasting future housing requirements.

In a continuing effort to support the housing office with forecasting tools, TRAC-Monterey will develop a database containing customer information necessary to complete the housing application form. The database builds upon previous TRAC-Monterey work to develop housing forecasting tools. TRAC-Monterey provided technical support to develop the housing office's web site that includes an electronic registration form. By completing the registration page, customers can electronically submit application data via e-mail directly to a counselor's email address. Although useful, information in e-mail format is difficult to manipulate or query unless converted to another application. The newly developed database will accept electronically transmitted data directly into the database, eliminating the process of converting e-mail information to a usable form.

Once in the database, information could be queried as necessary to assess housing requirements. The database, in Microsoft (MS) Access format, will also allow the counselors to modify the customers information and print DD Form 1746 - Application for Assignment to Housing. Future research includes developing a relational database linking maintenance activities and other tracked data with housing assignments. Potential long range efforts include replacing the existing FAMIS housing database with a relational Access database and integrating the database using friendly applications to navigate and modify database fields.

PROPOSAL OF WORK

TRAC-Monterey will lead development of an MS Access database that accepts electronically submitted information from the housing web site. The database will allow housing counselors to automatically produce and print DD Form 1746 - Application for Assignment to Housing. TRAC-Monterey will also provide training to housing counselors on procedures for producing the form from the Access database. TRAC-Monterey will also assist the private contractor tasked to maintain the housing web site with technical advice. Assistant includes recommendations to ensure electronically submitted information is sent using necessary protocols to populate the Access database.

REQUIREMENTS AND MILESTONES

- Develop MS Access database with tables and DD Form 1746 (OCT 99).
- Connect Web-site form to MS Database using CGI (NOV 99).
- Coordination with housing office to use database (DEC 99).
- Write technical report (MAR 99)

DELIVERABLES

- MS Database with DD Form 1746.
- Web-site Form to Database connection.
- Technical Report.

ESTIMATED MAN YEARS

- Lead investigator: 1/8 man years.

LEAD INVESTIGATOR

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JANUS 7.06DC HLA INTEGRATION AND COMPLIANCE TESTING

PROJECT FY00-08

CLIENT ORGANIZATION

Headquarters, U.S. Army TRADOC Analysis Center (TRAC)-White Sands Missile Range (WSMR), ATTN: ATRC-WJ, Wargaming Directorate, White Sands Missile Range, NM 88002-5502. Point of Contact: Dr. Randall M. Parish, Director, Wargaming Directorate, White Sands Missile Range, NM 88002-5502, (505) 678-1950, DSN 258-1950. parishr@trac.wsmr.army.mil

PROBLEM STATEMENT

In September 1996, the Under Secretary of Defense for Acquisition and Technology (USD(A&T), Dr. Paul Kaminski, signed a letter establishing the High Level Architecture (HLA) as the architecture for Department of Defense (DOD) simulations. In addition, the letter directs that legacy DOD simulations are to be brought into compliance with HLA or retired. On 7 April 1998, Under Secretary of Defense for Acquisition and Technology (USD(A&T), Dr. Jacques Gansler, approved the HLA Transition Report and reaffirmed the policy letter of September 1996.

HLA compliance delivers new functional capabilities and allows different organizations to produce/maintain a diverse set of products (e.g., simulations, live system interfaces, utilities, runtime infrastructures) that can be linked together in different combinations with reduced effort and increased potential for improved interoperability. This yields reuse of individual products and allows simulations to bring in new capabilities without having to build them. This in turn equates to reductions in time, expense, and risk that justify the modest near-term costs of transitioning legacy systems to the HLA.

Current versions of the legacy ground combat simulation Janus are not HLA compliant and face retirement on October 1, 2000. Many Janus users throughout DoD rely on Janus to meet their training needs. Therefore, a need for Janus exists and will continue to do so until next generation simulations such as OneSAF are fielded.

PROPOSAL OF WORK

TRAC-Monterey in cooperation with TRAC-White Sands will integrate an HLA capability into Janus and undergo the required HLA compliance testing process. This effort will increase the potential for Janus to interoperate with other HLA compliant simulations. This also guarantees no short falls will occur in the modeling and simulation (M&S) and training communities before Janus can be replaced by next generation simulations still in development.

TRAC-Monterey will leverage subject matter expertise and programming experience necessary to modify and employ software required for HLA compliance testing. TRAC-

WSMR will provide Janus 7.06D source code and subject matter expertise necessary to modify or implement any changes necessary for compliance testing. The HLA compliance testing will occur at White Sands Missile Range, NM.

REQUIREMENTS AND MILESTONES

Task 1 - Specify requirements of compliance testing (31 JAN 00).
- Obtain necessary software
- Develop test scenario
- Review test procedures
- Submit application for testing

Task 2 - Prepare and submit conformance notebook (29 FEB 00).
- Develop conformance statement
- Develop Janus SOM
- Edit RPR-FOM
- Develop scenario data and edit both object models.

Task 3 - Develop and submit test environment data (31 MAR 00).
- Set up system configuration for testing
- Develop RTI RID and FED files
- Rehearse test procedures

Task 4 - Conduct HLA compliance testing and document project (30 APR 00).
- Educate TRAC-WSMR Janus staff on HLA compliance testing procedures
- Conduct testing procedures on-line with DMSO certification agent
- Obtain HLA compliance certificate and complete compliance testing survey
- Document test process

DELIVERABLES

- Task 1 - Software requirements specification, Test scenario, Test application.
- Task 2 - Conformance notebook, Janus SOM, Edited RPR-FOM.
- Task 3 - RTI file, FED file, Test environment data.
- Task 4 - HLA compliance certification, technical report.

ESTIMATED MAN YEARS

- Lead Investigator: 1/4 man years.
- Senior Programmer: 1/4 man years.

LEAD INVESTIGATOR

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REFERENCES

Loper, Margaret, "Test Procedures for High Level Architecture Interface Specification," Version 1.3, May 1998, Online at http://hla.dmso.mil/testing/

Horst, Margaret, "Test Procedures for High Level Architecture Object Model Template," Version 1.3, April 1998, Online at http://hla.dmso.mil/testing/

Woldt, Michael, and Laura Burkhart, "HLA Federate Compliance Testing: Keys to a Successful Test," Proceedings of the 1999 Spring Simulation Interoperability Workshop, March 1999.

Pratt, Shirley, unpublished research report entitled "Soldier Station HLA Federate Compliance Testing," December 1998.

AUTOMATED UNIVERSAL DATA COLLECTION AND ANALYSIS TOOL (AUDCAT)

PROJECT FY00-09

CLIENT ORGANIZATION

U.S. Army Aviation and Missile Command (AMCOM), ATTN: AMSAM-RD-SS-AA (L. Fraser), Redstone Arsenal, AL 35898-5000. Point of Contact: Ms. Laurie Fraser, Director Advanced Prototyping, Engineering, and Experimentation Lab, (256) 842-0942 DSN: 788-0942. lfraser@redstone.army.mil

PROBLEM STATEMENT

Data collection and analysis is a central issue in distributed simulation. This capability is critical to all Army domains: ACR, RDA and TEMO. It affects the conduct of studies, testing and experimentation, and after action review. State of the art M&S technologies are required to effectively collect and analyze data from a distributed High Level Architecture (HLA) simulation sessions. The ongoing TRAC-Monterey research project titled "A Federate for Data Collection and Analysis" designed a general purpose method that automated the procedures required to join an arbitrary HLA Federation that uses any Federation Object Model (FOM) in order to collect data for analysis. That project used the Vision XXI software as the graphical user interface. This Vision XXI GUI approach required that the collected data be mapped to the Vision XXI standard data representation before it could be analyzed.

The AMCOM Data Collection and Analysis Tool (DCAT) is designed to provide the analyst with the ability to perform analysis that requires arbitrary queries on data that was generated from Distributed Interactive Simulation (DIS) experiments. DCAT does not perform these queries on databases that contain arbitrary object representations.

Various agencies would like to use the native FOM object representations when they analyze data from the distributed HLA simulations. This approach requires analysts to adapt their analysis techniques to accommodate the different FOM object representations they will encounter. These new analysis techniques will include the requirement to perform arbitrary queries on data in the native FOM object representations. This analysis approach eliminates the requirement to manually write FOM specific mappings to standard data representations.

This project proposes to deliver a software solution that will enable analysts to use automated procedures to use arbitrary queries to perform analysis in HLA federations that use different FOM object representations.

PROPOSAL OF WORK

TRAC-Monterey is partnering with AMCOM on this SIMTEC-funded project to deliver the required software solution. TRAC-Monterey will use the Analysis Federate listener functionality to provide the ability to automatically subscribe to High Level Architecture (HLA) data from any Federation that uses any Federation Object Model (FOM). TRAC-Monterey will output this information in a database format that is compatible with AMCOM's DCAT analysis tool. AMCOM will modify DCAT to provide the functionality that allows arbitrary queries into databases that use arbitrary object models.

REQUIREMENTS AND MILESTONES

- Initial Specifications and NT RTI Integration (21 NOV 99).
- Initial Operational Capabilities (IOC) Support (12 DEC 99).
- Final Delivery (31 JAN 00).

DELIVERABLES

- Initial Specifications and NT RTI Issues Report.
- Final Specifications, Source Code for Communications Package, Analysis Federate Prototype, Data Generation Federate.
- Final Analysis Federate Prototype executable and GUI, Source Code for Communications Library, Technical Report.

ESTIMATED MAN-YEARS REQUIRED

- Lead Investigator: 1/4 man-year.
- Senior Programmer: 1/4 man-year.

LEAD INVESTIGATOR

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ATTRITION CONCEPT VALIDATION

PROJECT FY00-10

CLIENT ORGANIZATION

Headquarters, U.S. Army TRADOC Analysis Center (TRAC), ATTN: ATRC, Fort Leavenworth, KS 66027. Point of Contact: Mr. Michael F. Bauman, SES, Director, TRAC. DSN: 552-5132. baumanm@trac.army.mil

PROBLEM STATEMENT

Validity of aggregate attrition algorithms can been a contentious issue. Attrition experts often have divergent views of how to test and validate various aggregate attrition algorithms. The JWARS model is considering use of the Division Level Combat Model (DIVLEV) to drive their aggregate attrition. Another option for aggregate attrition is the Bonder-Farrell method. I will investigate the validity of each model against doctrinal combined arms ground warfare scenarios.

PROPOSAL OF WORK

Develop two Java-based attrition algorithms based on the DIVLEV model and Bonder-Farrell methodology. Run each model in an attack, movement to contact and defensive scenario. Probable terrain includes Fort Hunter Liggett and/or Southwest Asia. Develop appropriate MOPs for comparison between DIVLEV and Bonder-Farrell. Execute the scenarios, conducting a sufficient number of runs to achieve a satisfactory sample size. Compare the results using a variety of rigorous statistical methods. At the conclusion, provide a summary of my findings to the JWARS office to support attrition model decisions.

REQUIREMENTS AND MILESTONES

- Develop Java modules (FEB 00).
- Develop scenarios and MOPs (FEB 00).
- Run scenarios (MAR 00).
- Conduct statistical analysis (APR 00).
- Report conclusions and recommendations (JUN 00).

DELIVERABLES

- Master's thesis.

ESTIMATED MAN YEARS

- Lead investigator: 3/4 man years.

LEAD INVESTIGATOR

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REFERENCES

S. Bonder and R.L. Farrell (eds.), "Development of Models for Defense Systems Planning," Report No. SRL 2147 TR 70-2, Systems Research Laboratory, The University of Michigan, Ann Arbor, MI, September 1970.

Command and Control Technical Center (CCTC), "Vector-2 System for Simulation of Theater-Level Combat, TM 201-79, Washington, DC, January 1979.

J.G. Taylor, "A Tutorial on the Determination of Single-Weapon-System-Type Kill Rates for Use in Lanchester-Type Combat Models," NPS 55-82-021, Naval Postgraduate School, Monterey, CA, Aug. 1982 (ADA124937).

US Army Material Systems Analysis Activity (AMSAA), "Computation of Direct-Fire Weapon Kill Rates for DIVLEV," Interim Note No. C-124, unpublished draft dated June 1983.

US Army Modeling and Simulation Office (AMSO), "Recommended Attrition Model for JWARS," PowerPoint Presentation, received April 1998.

US Army TRADOC Analysis Center (TRAC), "Vector-In-Commander, Executive Summary," April 1997.

KNAPSACK CUTS AND EXPLICIT-CONSTRAINT BRANCHING FOR SOLVING MIXED-INTEGER PROGRAMS

PROJECT FY00-11

CLIENT ORGANIZATION

Operations Research Department, Naval Postgraduate School, Monterey, CA 93943.

PROBLEM STATEMENT

Enhanced solution techniques are needed for solving integer programs (IPs) and mixed-integer programs (MIPs). Previously unsolvable problems will be solved with these new techniques. We have developed knapsack cut-finding procedures for minimal cover cuts, and converted existing cut-strengthening theory into practical procedures that lift and tighten violated minimal cover valid inequalities to violated knapsack facets. We have discovered a new class of knapsack cuts called 'non-minimal cover cuts' and a method of lifting them called 'deficit lifting'. Deficit lifting enables all of these cuts to be lifted and tightened to facets as well. Extensions of these techniques have enabled us to find cuts for elastic knapsack constraints and cuts for non-standard knapsack constraints. We also have developed the new technique of "explicit-constraint branching" (ECB). ECB enables the technique of constraint branching to be used on IPs and MIPs that do not have the structure required for known "implicit-constraint branching" techniques. Preliminary research has showed these techniques to have promise. When these techniques are applied to 84 randomly generated generalized assignment problems, the combination of knapsack cuts and explicit-constraint branching were able to solve 100% of the problems in under 1000 CPU seconds. Explicit constraint branching alone solved 94%, and knapsack cuts solved 93%. Standard branch and bound alone solved only 38%. The benefits of these techniques have also been demonstrated on some real-world generalized assignment and set-partitioning problems. The challenge that remains is to publish and present our preliminary results, and to prove the robustnesss of our techniques by testing and extending these results to solve more difficult, real-world problems.

PROPOSAL OF WORK

TRAC-Monterey will publish preliminary results in refereed OR journals and continue to work on solving more difficult problems.

REQUIREMENTS AND MILESTONES

- Publish ECB results (paper accepted JUL 99)
- Complete analysis of NMCC effectiveness on current test problems (DEC 99)
- Obtain more difficult, real-world problems. (DEC 99)
- Test and adapt techniques. (MAR 00)
- Complete Knapsack Cut paper. (AUG 00)

DELIVERABLES

- Two published papers.
- Executable software.
- Presentation.

ESTIMATED MAN YEARS

- Lead investigator: 1/2 man years.

LEAD INVESTIGATOR

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REFERENCES

Appleget, JA (1997), "Knapsack cuts and explicit-constraint branching for solving integer programs," Ph.D. dissertation, Naval Postgraduate School, Monterey, CA, June 1997.

Appleget, JA, Wood, RK, "Explicit-constraint branching for solving mixed-integer programs," (TBP).

IV. UNFUNDED RESEARCH FOR FY00

OneSAF ARCHITECTURE SPECIFICATION (OneSAF Architecture)

PROJECT FY00-12

CLIENT ORGANIZATION

Headquarters, US Army Training and Doctrine Command (TRADOC), Deputy Chief of Staff for Training, Attn: ATAN ATTG-O, TRADOC Project Officer OneSAF. Point of Contact: LTC David Vaden. DSN 680-5954. vadend@monroe.army.mil

PROBLEM STATEMENT

Architecture development follows requirements development and precedes or parallels everything that follows in software development; it is the next major step for the OneSAF program. Most simulation architectures evolve as the simulation develops and are primarily defined by the choice of hardware, support software and programming language. OneSAF will not meet requirements without a carefully defined architecture. The OneSAF test bed can mitigate risk in other technical areas, but it can't address the most significant risk: the OneSAF objective system architecture.

OneSAF core requirements include (1) represent entity through BDE combat; (2) be HLA compliant; (3) replace ModSAF, CCTT SAF, JANUS and BBS; (4) interface with WARSIM; (5) model CAS, JA/AT, & Naval Gunfire effects; (6) simulate littoral conditions; (7) simulate limited MOUT; (8) be composable; (9) be interoperable with constructive, virtual, and live simulations and C4I systems; (10) be scalable; and (11) be expansable.

The OneSAF architecture must support composability so that OneSAF can replace several other simulations, interoperate with a broad set of models and C4I systems, and be expansable for future requirements. The key to being able to compose a simulation for a specific purpose in OneSAF is the ability to select from an expansible set of components (terrain, entity representations, etc.) and options (closed-loop versus human-in-the-loop, SAF behaviors, etc.).

PROPOSAL OF WORK

TRAC-Monterey proposes to (1) write an architecture specification, (2) submit the specification for a broad review, and (3) consult on the architecture with OneSAF developers.

Architecture is the structure of components in a system, their relationships and principles, and the guidelines governing their design and evolution over time. Architecture includes the system framework that facilitates interoperability of models and simulations as well as reuse of

simulation components. The system architecture is a high-level software design that bridges the gap between the user requirements and the detailed design. It organizes and explains what the system will do in an abstract manner.

The OneSAF architecture specification will describe the program organization, the enhancement strategy, software models and code identified for re-use, major data structures, key algorithms, major object models, generic functionality, error processing and robustness considerations, and performance goals. These sections are described below.

Organization. This section defines the major modules in OneSAF and discusses their purpose. It maps functions to modules and documents preliminary module interfaces. A module encapsulates a collection of closely related objects and other data or services.

Enhancement. This section identifies planned enhancements beyond the initial operating capability and ensures that the overall design accommodates those enhancements.

Reuse. This section identifies candidate models and code for re-use. OneSAF will reuse models from COMBAT XXI, WARSIM and other sources. Much of this model reuse will be achieved through reuse of class designs. The ability to use or extend previously designed and developed class structures is an important aspect of reuse in OneSAF. Class design reuse provides common naming conventions, data types, attributes and methods.

Data Structures. This section identifies and discusses the major, common data structures such as the use of priority queues for simulation events. OneSAF data will be easily modified through a user interface.

Algorithms. This section identifies and discusses the key algorithms. Algorithms are the simulation specific processes acting on a wide range of objects such as search and detection.

Models. This section contains the design for major classes. The COMBAT XXI classes will be the basis for OneSAF class designs; however, these classes will be reviewed and tested with OneSAF use cases that go beyond the COMBAT XXI requirements. This section will form the basis for subsequent detailed class design.

Generic Functionality. This section describes generic functionality such as the graphical user interface, input/output and memory management. A key aspect of this section will be generic functionality to enable OneSAF to operate as a distributed model.

Error Processing. This section describes error handling and robustness requirements. It will specify a consistent strategy for error handling and establish conventions for error messages. It will also provide general requirements for fault recovery.

Performance. This section lists key performance goals. It will provide speed and memory use goals for areas of particular risk such as simulation event and time management.

REQUIREMENTS AND MILESTONES

The project consists of three phases each culminating with a written product.

Phase I. Preliminary Architecture Definition (March 2000). In Phase I, we will draft an architecture specification. Phase I culminates with distribution of the draft OneSAF Architecture Specification.

Phase II. Architecture Review (June 2000). In Phase II, we will lead a broad and formal review of the draft architecture. We will also continue to refine the class design for the object models. Phase II culminates with distribution of the revised OneSAF Architecture Specification.

Phase III. Architecture Development Support (September 2002). In Phase III, we will consult with OneSAF developers during the detailed design and implementation stages of the project. Phase III culminates with delivery of the final comprehensive technical report that describes the OneSAF architecture development project.

DELIVERABLES

- Draft OneSAF Architecture Specification (Phase I)
- Revised OneSAF Architecture Specification (Phase II)
- Final Technical Report (Phase III)

ESTIMATED MAN YEARS

- Investigators: 1/4 man year per investigator.

LEAD INVESTIGATOR(S)

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WEB-BASED SIMULATION FOR COMBAT MODELING INSTRUCTION AND DISTANCE LEARNING (WEB SIM)

PROJECT FY00-13

CLIENT ORGANIZATION

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PROBLEM STATEMENT

Technical Description. This research address three closely related problems.

(1) Most current simulations are not well suited for distance learning. Many are only marginally functional for resident learning. They typically require special hardware, and special training to operate.

(2) There are no readily available coded combat modeling examples for student research. This prevents combat modeling students from directly exploring the behavior of algorithms and from experimenting with various implementations.

(3) There is no library of re-usable simulation components. Operations Research students frequently construct simulations with combat models as part of their thesis research. In most cases, the student must create the simulation from scratch. Simulation development efforts such as COMBAT XXI need similar components.

Background. The United States Military Academy (USMA) Systems Engineering Department, the Naval Postgraduate School (NPS) Operations Analysis (OA) Department, and the Air Force Institute of Technology (AFIT) Department of Operational Sciences (OS) teach combat modeling and related subjects. These academic institutions and several military schools such as the command and staff colleges and the war colleges support instruction with wargaming and simulation. These institutions use a variety of aging legacy models.

The TRADOC Analysis Center (TRAC) at White Sands, New Mexico (TRAC-WSMR) is developing COMBAT XXI to replace CASTFOREM, an analytical constructive simulation of combat at the brigade and battalion level. The development team has selected Java and is evaluating and using components developed by NPS. The NPS Loosely Coupled Components (LCC) working group has prototyped several software components in Java that support simulation. Four prominent prototypes are described below.

(1) **Simkit** is a discrete event simulation framework based on the event diagram paradigm. The NPS OA faculty and students and the AFIT OS faculty and students use Simkit

extensively for instruction and thesis research. The COMBAT XXI development team is using Simkit in their prototype development and is evaluating Simkit for production use in COMBAT XXI.

(2) **ModTerrain** is a modular terrain component designed to allow simulation developers to substitute one terrain representation for another within the same simulation. It includes routines to access terrain elevation and feature data and high level terrain-related algorithms such as line of sight. An NPS student has coded a reference implementation of ModTerrain in Java using Janus terrain and algorithms. ModTerrain will be nominated as an Army standard in Fiscal Year 2000 after extensive experimentation with a prototype reference implementation in C++ using ModSAF Compact Terrain database (CTDB). COMBAT XXI will use a Java implementation of ModTerrain.

(3) **Flora** is an interactive, geo-referenced map and overlay display component. It supports standard features such as pan, zoom, fade, and enhance. It displays the cursor elevation and location in lat/long and UTM. Flora uses NIMA provided ADRG and DTED data or any other geo-referenced image such as a satellite map. Flora displays standard military symbols on overlays. The original version of Flora is used by NATO contingency planners. COMBAT XXI is evaluating Flora for their development effort.

(4) **König** is a framework for modeling and solving graph and network problems. It provides dynamic attribute sets that are well suited for entity modeling. König is used at the NPS and at AFIT for thesis research and by the National Security Agency (NSA) for algorithm development.

PROPOSAL OF WORK

This research has two phases. The first phase culminates with the completion of the Joint Combat Modeling resident course. Architecture development and basic component implementation are the critical activities in this phase. In the second phase, the course content from phase I will be packaged for distance learning via the internet.

The research team will design a simulation architecture and develop web-based simulation components in Java. Sun Microsystems describes Java as a “simple, object-oriented, network-savvy, interpreted, robust, secure, architecture neutral, portable, high-performance, multithreaded, dynamic language.” Java is a high-level (i.e., third-generation) programming language designed for use in a distributed environment such as the Internet. It is similar to the C++ language, but it is simpler and more fully object-oriented. Java can be used to create complete applications that may run on a single computer or be distributed among servers and clients in a network. It can also be used to build small application modules or applets for use as part of a web page.

REQUIREMENTS AND MILESTONES

Phase I. (12 months)

The first step of Phase I is to design the simulation architecture while implementing critical simulation components and designing the resident and non-resident combat modeling course content. The second step of Phase I is to integrate components into the architecture while developing the residence course content. The final step of Phase I is to integrate simulation components and resident course content while validating the resident course.

Phase II. (6 months)

The first step of Phase II is to develop the non-resident course using the resident course content. The second step of Phase II is to integrate the simulation components into the non-resident course content. The final step of Phase II is to prototype and validate the distance learning combat modeling course.

DELIVERABLES

- Java Software Components. This research will produce several re-usable software components implemented in Java.
- Joint Combat Modeling Course. This research will integrate simulation components into a combat modeling course and produce a set of course content to support resident and distance learning.
- Technical Report. This research will produce a comprehensive technical report that documents the software components. It will also produce various thesis products by masters students and various papers by members of the research team.

ESTIMATED MAN YEARS

- Lead investigator: 1/4 man years.

LEAD INVESTIGATOR

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HIGH LEVEL ARCHITECTURE (HLA) DYNAMIC SCENARIO BUILDER (DSB)

PROJECT FY00-14

CLIENT ORGANIZATION

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PROBLEM STATEMENT

Current simulations do not share scenario data developed by their scenario generation systems. As simulations continue to be networked together as part of the High Level Architecture (HLA), simulations must be reentered by hand or are created from scratch rather than reusing existing scenarios.

Recent TRAC-Monterey research resulted in the development of draft standards for simulation scenario interoperability. The standards, called the High Level Architecture (HLA) Dynamic Scenario Builder (DSB), describe a language for specifying scenarios using the eXtensible Markup Language (XML). These standards need to be applied to an HLA simulation to prove the concept and mature the standards.

PROPOSAL OF WORK

TRAC-Monterey has developed an HLA-compliant NT-based constructive simulation based on Janus called HLA Warrior. HLA Warrior can import and export Janus scenarios. It should be evolved to become HLA DSB-compliant by adding scenario input and export routines that manipulate the standard's XML files. This can partially be accomplished through the use of Commercial Off-The-Shelf (COTS) XML parser routines. However, modifications will be required to add the remaining required routines to HLA Warrior.

Specifically, we propose:

1) Specifying the requirements of the concept demonstration HLA DSB-compliant variant of HLA Warrior,
2) Designing new required routines and the modifications for the existing code baseline,
3) Coding the new routines and making required changes to existing code,
4) Testing and demonstrating the resulting system with Janus scenarios.

REQUIREMENTS AND MILESTONES

- Task 1 - Specifying the requirements of the concept demonstration HLA DSB-compliant variant of HLA Warrior,
- Task 2 - Designing new required routines and modifing the existing code baseline,
- Task 3 - Coding the new routines and making required changes to existing code,
- Task 4 - Testing and demonstrating the resulting system with Janus scenarios.

DELIVERABLES

- Monthly one-page status reports documenting progress of milestone objectives/goals, obstacles encountered and expenditures.
- Software Requirements Specification
- Software Modification Design Document
- New and Modified Software Code
- Final technical report.

ESTIMATED MAN YEARS

- Lead Investigator: 1/4 man years.
- Senior Programmer: 1/2 man years.

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REFERENCES

Lacy, Lee; George Stone III; Theodore D Dugone. “XML Data Interchange Format Standards for HLA-Related Data Interoperability”. Proceedings of the Southeastern Simulation Conference ’99 (in press).

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U.S./FRENCH HIGH LEVEL ARCHITECTURE (HLA) FEDERATION

PROJECT FY00-15

CLIENT ORGANIZATION

Headquarters, U. S. Army TRADOC Analysis Center (TRAC), ATTN: ATRC, Fort Leavenworth, KS. Point of Contact: Mr. Michael F. Bauman, SES, Director, TRAC, Fort Leavenworth, KS 66027. (931) 684-5132, (DSN: 552-5132), baumanm@trac.army.mil

PROBLEM STATEMENT

In November 1998, TRAC-Monterey agreed to participate with the French in a High Level Architecture (HLA) exercise as part of the DEA-F-1200 exchange agreement. The project follows the standard Federation Development and Execution Process (FEDEP) Version 1.4 step by step. The project has two phases. Participants agreed to fund Phase I and seek funding for Phase II. Phase I concludes in November 1999 with the completion of a majority of the first three steps of the FEDEP. Phase II completes the remaining steps of the FEDEP including both co-located and cross-continent federation execution. Pending funding Phase II culminates in December 2000 with DMSO HLA certification for all federates.

PROPOSAL OF WORK

A U.S. team led by TRAC-Monterey and a French team from DGA/CAD (the Center for Defense Analyses) and will continue to work through the HLA FEDEP process as part of Phase II of a U.S./French project to create an HLA federation.

The overall goal of the project is to demonstrate the ability to federate French and U.S. simulations across-continent via a global communications network, using the HLA standard. Other goals include: investigating HLA data collection and analysis techniques, completing DMSO HLA compliance certification, and capturing and documenting lessons learned.

The reusable HLA federation created from this project will be the first HLA federation created at TRAC-Monterey and serve as a platform for developing and testing future HLA projects undertaken by TRAC-Monterey. The projects directly benefiting from this research include: Automated Study Question Methodology Tool (ASQMT), High Level Architecture Dynamic Scenario Builder (HLA DSB), Automated Universal Data Collection and Analysis Tool (AUDCAT), and the Automatic Simulation Object Model (SOM) generation tool.

Lessons learned will be thoroughly documented in the form of papers, presentations, recommended changes to current standards, and technical reports and made available to modeling and simulation user community to support future HLA federation developers. The lessons learned should also facilitate the ability of the two countries involved in the project to inter-operate and enter into future HLA federations.

The HLA federates involved in the project include:

- HLA Warrior (U.S.): A high-resolution simulation of military combat operations. The HLA Warrior project is re-hosting Janus on a personal computer (PC) running the Windows NT operating system and re-engineered Janus as an object oriented, distributed simulation. Spectrum 2.0 development will add non-combat military operations and C4I interfaces to HLA Warrior.

- ELYSA (France): An air defense application developed in the French HLA ESCARDE simulation development environment. Its primary purpose is to model air defense engagements. Since ESCARDE is a full simulation support environment, HLA compliance for ELYSA will support HLA compliance for all simulations developed in ESCARDE with significant direct code re-use.

- Analysis Federate (U.S.): A re-usable HLA data collection and analysis tool that supports after action review. It was developed as a 1998 SIMTECH project and has been incorporated into the most recent JADS experiment and the Eagle/ModSAF federation. It is the basis for AUDCAT, the Automated Universal Data Collection and Analysis Tool.

REQUIREMENTS AND MILESTONES

Task 1 - Design and develop federation (31 MAY 00).
- Prepare federation development plan
- Write simulation input files
- Implement federate modifications

Task 2 - Design and build RTI interface for federates (31 JUL 00).
- Participate in software design and code reviews of the RTI interface
- Write software interface between RTI and both federates
- Perform inter-federate testing

Task 3 - Federation integration and testing (30 SEP 00).
- Evaluate scenario for correctness and completeness
- Perform examination to determine latency issues
- Perform time management evaluation
- Complete federate management tool selection and training
- Analyze network bandwidth requirements and select global communications network

Task 4 - Federation execution and compliance testing (30 NOV 00)
- Secure dedicated communication network for cross-continent implementation
- Perform HLA compliance testing
- Implement co-located and cross-continent federation execution

Task 5 - Analyze results and prepare documentation (31 DEC 00)
- Determine reusable federation products
- Document FEDEP process and recommended changes to the process

- Prepare technical report

DELIVERABLES

- Task 1 - Federation development plan, simulation input files, modified federates.
- Task 2 - RTI interface for all federates.
- Task 3 - Integration and testing document.
- Task 4 - HLA compliance certification for all federates, repeatable and reusable HLA federation.
- Task 5 - Technical report, documented lessons learned about the FEDEP, HLA certification process, HLA data collection and analysis, and cross-continent federation techniques.

ESTIMATED MAN-YEARS

- Lead Investigator: 1/2 man-year.
- Senior Programmer: 1/2 man-year.

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SIM CLINIC 2001

PROJECT FY00-16

CLIENT ORGANIZATION

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PROBLEM STATEMENT

The Headquarters, Air Education and Training Command (HQ, AETC) is reviewing current means and methods for teaching and instructing medical personnel with the Air Force Medical Services (AFMS). They are interested in utilizing modern technology to improve current teaching methods within the primary care team training cycle. Specifically, they would like to develop a hospital simulation, called SimClinic 2001, that exercises the primary care team in the decision making process within a virtual hospital environment.

As outlined by the client, the SimClinic 2001 will:

"… be a virtual Primary Care Clinic designed to provide an integrated training model for the primary care management teams. Further modifications of SimClinic 2001 will follow the career progress of the initial primary care teams. Senior staff will interact in a virtual clinic simulation with Primary Care team members by imputing decisions based on their roles in response to the computer-based scenario. Participants will learn to deal with and optimize patient management (access, scheduling, referral, follow-up, education, etc.), resourcing, space utilization and patient flow, staffing, and other related issues. SimClinic 2001 will augment other in-house and Executive Skills training modalities and use lessons learned from the field to enhance its capability. It will employ a “war gaming” approach to common leadership situations applicable to Primary Care and will also be made available through the VMHI. The funding includes initial software development, fielding and maintenance."

This concept was presented to the Surgeon Generals for each Major Command (MAJCOM/SGs) in August 1999 and was tabled at the AFMS General Officer Round Table Conference on 7 October 1999. With approval, the intended timeline for providing a working simulation for the Primary Care Training (PCT) is expected in October 2003.

PROPOSAL OF WORK

This research requires four phases. The first phase is the selection and purchase of a Commercial-Off-The-Shelf (COTS) software that meets minimum requirements for modification. The client must identify these requirements in terms of what needs to be in the simulation. If no acceptable COTS software is available, a contract for the software

development of an equivalent simulation is required. During this phase, identification of the data requirements for the simulation and the collection of this data is required.

The second phase is the modification of the COTS software to incorporate all requirements for a training simulation. Two major aspects of the modification phase are:

- The evaluation of the COTS source code to identify the structure and architecture; and
- Modification of the source code into a realistic hospital virtual simulation.

If no acceptable COTS alternative is found, then a ground-up development is required. This will require identifying software developers, writing Statements of Work (SOW), and contracting to develop the final SimClinic 2001 simulation software.

The third phase of this project is the launching of a test-bed version of the modified code to the end-user. This will provide feedback from the users as to the ease of use as well as training benefits gained by the hospital simulation. Recommended changes to the SimClinic 2001 code will be fielded by TRAC-Monterey for inclusion into future version releases.

The fourth phase is the launching of the final version to the end-user. This will allow the end-user to implement the SimClinic 2001 hospital simulation software into the PCT plan. This will require TRAC-Monterey to advise and recommend hardware requirements for the successful launching of the SimClinic 2001 simulation.

REQUIREMENTS AND MILESTONES

- Purchase of COTS or identify software development agent. (Mar 00)
- Collection of data to support simulation. (Oct 01)
- COTS evaluation and re-coding into SimClinic. (Oct 02)
- SimClinic 2001 beta testing phase and evaluation. (Feb 03)
- Implementation of SimClinic 2001 into training plan. (Oct 03)
- Write technical report. (Nov 03)

DELIVERABLES

- COTS evaluation and purchase or software developer agent identification.
- Completion of data collection for simulation.
- SimClinic 2001 beta release.
- SimClinic 2001 implementation and roll-out.
- Technical Report.

ESTIMATED MAN YEARS

- Lead investigator: 1/2 man years.

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